

CASE HISTORY
RAPID RESPONSE ASSEMBLY AND OPERATION OF A
TWO MILLION GALLON PER DAY ACID MINE DRAINAGE
TREATMENT PLANT
CROSSVILLE COAL PIT
CRAB ORCHARD, TENNESSEE₁

Don Budeit₂

Abstract

A pit 150 feet deep reportedly containing 70 million gallons of acidic water had reached the overflow point and was in violation of U.S. Office of Surface Mining and Tennessee Department of Environment and Conservation discharge limitations. Within six days of initial contact, Environmental Solutions LLC installed a complete treatment plant for the 3.1 pH water containing 102 milligrams per liter total iron and 148 milligrams per liter manganese. After the first week of operation, it was determined that the pit was being fed from underground mine pools covering 92 acres and may contain as much as 700 millions gallons. In addition, average annual rainfall of 50 inches and snowfall of 12 inches adds more than 60 million gallons of acidic water to the pit. A second treatment system was installed three weeks later to double treatment from 2 million gallons per day to 4 million gallons per day. This paper will document the installation and operation of this treatment facility that drastically reduced treatment costs.

₁Paper was presented at the 2006 National Association of Abandoned Mine Land Programs 28th Annual Conference, September 25-27, 2006, Billings Mt.

₂Don Budeit, President Environmental Solutions LLC, Moon Township, Pa.
15108

Introduction

Environmental Solutions LLC was contacted by management of Crossville Coal Inc located at Crab Orchard, Tennessee. The company had a problem that required immediate attention. A pit 150 feet deep containing acidic mine water was filled to the brim and about to overflow despite a recently placed additional 10 foot berm. The company was in violation of the Tennessee Department of Environment and Conservation as well as the U.S. Office of Surface Mining discharge permits. Environmental Solutions personnel were on site the following morning, given a tour of the site and briefed on the current method of treatment. Crossville Coal already was pumping water from the pit into two treatment ponds at a higher elevation that flowed into a final settling pond before discharging into a stream. Treatment consisted of filling the first pond with acidic water, blowing a tanker of lime into the pond and repeating the procedure the following day and waiting another day before discharging the treated water into the second pond. The problem with the procedure was two fold. The batch treatment was unable to treat the water as fast as new inflow into the pit and the cost to treat was excessive.

Site Inspection and Proposal

On site Testing

After reviewing results of analysis of water in the pit prepared by the Office of Surface Mining and others, Environmental Solutions LLC personnel conducted their own on site testing and analysis to determine proper sizing of the system required to treat the reported 70 million gallons of water contained in the pit.

Initial plans

Crossville Coal Inc. planned to pump and treat water in the pit at a rate of two million gallons per day. They currently were using an 1800 gallon per minute diesel powered submersible pump to bring the pit water to the first of their three existing treatment ponds. The plan was to drain the pit of the acidic water and refill the pit with refuse bordering the pit. It was expected to be a two to three month project.

Equipment was to be installed on site until removal of the water and Crossville Coal personnel were to be trained to operate the equipment.

Proposal

Based on the data provided by Crossville Coal and the on site testing, Environmental Solutions prepared a proposal to deliver and install a six module system, operate the system during the first two weeks and train Crossville personnel. The equipment was to be removed at the completion of the project. The proposal was prepared on site and presented to Crossville Coal management.

Crossville Coal Inc is wholly owned by Hillsborough Resources of Vancouver B.C. The proposal was faxed to Hillsborough and during an immediate conference call, the proposal was accepted and an agreement written and signed that same day. The proposal called for installation of a three unit system as soon as possible and installation of a second three unit system within three weeks to double treatment capability.

Crossville Coal Pit

The pit covers an area of less than four acres, is 150 feet deep and was reported to contain 70 million gallons of 3.1 pH water containing 150 milligrams per liter iron and 148 milligrams per liter manganese.



Figure 1. Crossville Pit Note the 10 foot berm that was placed at the far end of the pit. The pit is surrounded with acres of acidic rock and ground water is directed to the pit.

The Treatment System

Maelstrom Oxidizer

The Maelstrom Oxidizer is a system for mass transfer of oxygen into water using high volume low pressure air to accelerate the oxidation and precipitation of metals. The system is comprised of individual modules contiguously aligned to bombard water repeatedly in successive reaction chambers. A pH controller

combined with a chemical feed pump maintains the required pH for cost effective treatment.

Installation

A three module system capable of treating two million gallons a day was delivered, installed and operating six days after signing of the agreement. A second three unit system was in operation three weeks later. The system was installed at ground level at the front center of the first treatment pond. Crossville Coal personnel installed pipes to carry the water being pumped from the pit to the treatment system

Chemical Feed

Because this was to be a short term treatment operation, sodium hydroxide was supplied in totes containing approximately 400 gallons each. Outflow from the four totes was combined to be metered by the chemical feed pump controller and pumped into the first chamber of the first module. The turbulent action resulting from the input of high volumes of air in the system mixed chemical with the 1800 gallon per minute inflow of acidic water being pumped from the pit.

Initial Operation

Initially, the 1800 gallon per minute diesel pump supplied water to be treated by the system. During the first three weeks of operation with a single three module system operating 24 hours a day, the mine pool was only lowered 13 inches. When the second three module system was installed, the volume being treated was three thousand gallons per minute and after more than two months of 24/7 operation the mine pool was only lowered 15 feet. At a rate of 4 million gallons per day, more than 200 million gallons were removed from the pit. The total surface area of the pit is 4 acres or less and the 14 feet removed with operation of the two systems equals only 18 million gallons. It became obvious that the open pit was being fed from Hugh pools of underground water adjacent to the pit. In addition to the mine pools, annual rainfall in the county is published as 52 inches and snow as 12 inches. Instead of this being a 60 to 90 day project, the treatment may be perpetual.

Treatment Modifications

Totes containing 20% Sodium Hydroxide were eliminated and replaced with an insulated 4000 gallon tank containing 50% Sodium Hydroxide. An unused guard shack was appropriated to house the pH controllers. The diesel pump bring water from the pit was replaced with electrical pumps.

Treatment Results

Effluent leaving the final pond, Basin 001 has always been in compliance with Tennessee Department of Environmental and Conservation and US Office of Surface Mining discharge requirements. Table 1. below was prepared by the Chief Engineer of Crossville Coal Inc.

	Maelstrom Oxidizer	Surge Basin 2	Surge Basin 1	Basin 001
--	-----------------------	---------------	---------------	-----------

Date	pH	pH	Mn	pH	Mn	pH	Mn
4/24/06	9.7	8.7	1.0	8.7	1.5	8.4	1.4
4/25/06	9.9	9.2	1.0	9.0	1.7	8.3	0.5
4/25/06	9.9	8.9	1.5	8.3	0.8	8.3	1.2
4/26/06	9.4	9.2	1.8	9.1	0.9	8.8	1.3
4/26/06	9.7	9.0	2.0	8.8	0.9	8.3	1.3
4/27/06	9.1	8.9	2.3	8.9	1.1	8.6	1.6
4/27/06	9.9	9.0	4.1	8.9	1.9	8.4	1.3
4/28/06	9.4	9.1	2.0	9.0	1.0	8.7	1.4
4/28/06	9.7	8.9	1.4	8.8	1.7	8.4	1.4
4/29/2906	9.9	8.9	1.1	8.8	1.7	8.2	1.8
4/30/06	9.7	9.0	1.5	8.7	1.1	8.4	1.6
5/01/06	9.4	9.1	1.1	8.6	1.8	8.3	1.4
5/01/06	9.6	9.0	1.1	8.6	1.0	8.4	1.6
5/02/06	9.6	9.0	1.1	8.9	0.8	8.3	1.8
5/02/06	9.5	8.9	0.8	8.5	2.0	8.2	1.5
5/03/06	9.5	8.6	0.7	8.4	1.3	8.1	1.8
5/03/06	9.2	8.9	0.8	8.6	1.0	8.6	1.0
5/04/06	9.5	9.1	0.6	8.8	0.9	8.6	1.4
5/04/06	9.7	9.0	0.7	8.9	1.2	8.1	1.4
5/05/06	9.7	9.1	0.6	8.6	0.5	8.4	0.6
5/05/06	9.7	9.1	0.5	8.7	0.7	8.6	1.6
5/06/06	9.7	9.1	0.4	8.9	0.5	8.0	1.1
5/07/06	9.5	8.9	1.5	8.9	0.7	8.6	1.0
5.08/06	9.7	8.8	2.3	8.8	0.4	8.7	1.0

Table 1.

Maelstrom Oxidizer Treatment System



Figure 2. Tank at the right is the chemical tank. Building in the middle houses the pH control system. Long pipes feed each of the two systems separately. The two systems are the black high density polyethylene units at the left.



Figure 3. View of the treatment system on the bank of Surge Basin 2.

Agreement Modification

Since the original agreement was intended to be short term treatment with the equipment being removed when the pit was drained, it was necessary to re-negotiate the agreement. Crossville Coal purchased the first system outright and is leasing the second system with an option to buy. Each of the systems is complete with their own chemical feed and pH control systems. Three modules comprise each system and they can be moved to any location readily.

Conclusion

Installation and operation of the initial system within a six day period prevented the pit from again overflowing and discharging water exceeding discharge limitations.

Treatment with the system is cost effective. Only as much chemical as is necessary to meet discharge limitations is used

Acknowledgements

The author would like to thank Mike Webster, plant manager of Crossville Coal Inc. and the mining company personnel that assisted in the installation and who currently are operating the system.